# MATHEMATICS VERTICAL ARTICULATION TOOL (MVAT)

# 2016 *Mathematics Standards of Learning* – Probability and Statistics

# Kindergarten-Algebra II Progression

**All K-8 Mathematics SOL for the Probability and Statistics strand are represented in this document. All End-of-Course Mathematics SOL are NOT represented.**

KEY TO COLORED BOXES: **ES** = K-5 Prior Knowledge Concepts; **MS** = 6-8 Prior Knowledge Concepts; **HS** = 9-12 Prior Knowledge Concepts; N/A = No Concepts Listed

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| **Grade  K** | **Grade  1** | **Grade  2** | **Grade  3** | **Grade  4** | **Grade  5** | **Grade  6** | **Grade  7** | **Grade  8** | **Related to Algebra 1** | **Related to Algebra 2** | **Measures of Central Tendency** |
| N/A | N/A | N/A | N/A | N/A | [**5.17a**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=41) | N/A | N/A | N/A | N/A | N/A | given a practical context, will describe mean, median, and mode as measures of center. |
| N/A | N/A | N/A | N/A | N/A | [**5.17b**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=41) | N/A | N/A | N/A | N/A | N/A | given a practical context, will describe mean as fair share. |
| N/A | N/A | N/A | N/A | N/A | [**5.17c**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=41) | N/A | N/A | N/A | N/A | N/A | given a practical context, will describe the range of a set of data as a measure of spread. |
| N/A | N/A | N/A | N/A | N/A | [**5.17d**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=41) | N/A | N/A | N/A | N/A | N/A | given a practical context, will determine the mean, median, mode, and range of a set of data. |
| N/A | N/A | N/A | N/A | N/A | ES | [**6.11a**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=30) | N/A | N/A | N/A | N/A | represent the mean of a data set graphically as the balance point. |
| N/A | N/A | N/A | N/A | N/A | ES | [**6.11b**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=30) | N/A | N/A | N/A | N/A | determine the effect on measures of center when a single value of a data set is added, removed, or changed. |
| N/A | N/A | N/A | N/A | N/A | ES | MS | N/A | N/A | N/A | [**AII.10**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=21) | represent and solve problems, including practical problems, involving inverse variation, joint variation, and a combination of direct and inverse variations. |
| N/A | N/A | N/A | N/A | N/A | ES | MS | N/A | N/A | N/A | [**AII.11a**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=22) | identify and describe properties of a normal distribution. |
| N/A | N/A | N/A | N/A | N/A | ES | MS | N/A | N/A | N/A | [**AII.11b**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=22) | interpret and compare *z*-scores for normally distributed data. |
| N/A | N/A | N/A | N/A | N/A | ES | MS | N/A | N/A | N/A | [**AII.11c**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=22) | apply properties of normal distributions to determine probabilities associated with areas under the standard normal curve. |
| N/A | N/A | N/A | N/A | N/A | ES | MS | N/A | N/A | N/A | [**AII.12**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=25) | compute and distinguish between permutations and combinations. |

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| **K-8 Cross-Strand Connections – Measures of Central Tendency** |
| **Number and Number Sense Connections**  **Computation and Estimation Connections**   * [**4.4d**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=14) **- create and solve single-step and multistep practical problems involving addition, subtraction, and multiplication, and single-step practical problems involving division with whole numbers.** * [**5.7**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=23) **- simplify whole number numerical expressions using the order of operations.**   **Measurement and Geometry Connections**  **Patterns, Functions, and Algebra Connections**   * [**6.12a**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=33) **- represent a proportional relationship between two quantities, including those arising from practical situations** * [**6.12b**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=33) **- determine the unit rate of a proportional relationship and use it to find a missing value in a ratio table** * [**6.12d**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=33) **- make connections between and among representations of a proportional relationship between two quantities** * [**7.10e**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=31) **- make connections between and among representations of a proportional or additive relationship between two quantities using verbal descriptions, tables, equations, and graphs.** * [**6.12c**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=33) **- determine whether a proportional relationship exists between two quantities** |

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KEY TO COLORED BOXES: **ES** = K-5 Prior Knowledge Concepts; **MS** = 6-8 Prior Knowledge Concepts; **HS** = 9-12 Prior Knowledge Concepts; N/A = No Concepts Listed

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| **Grade  K** | **Grade  1** | **Grade  2** | **Grade  3** | **Grade  4** | **Grade  5** | **Grade  6** | **Grade  7** | **Grade  8** | **Related to Algebra 1** | **Related to Algebra 2** | **Outcomes and Probability** |
| N/A | N/A | [**2.14**](https://www.doe.virginia.gov/home/showpublisheddocument/2950#page=33) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | use data from probability experiments to predict outcomes when the experiment is repeated. |
| N/A | N/A | ES | [**3.14**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=35) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | investigate and describe the concept of probability as a measurement of chance and list possible outcomes for a single event. |
| N/A | N/A | ES | ES | [**4.13a**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=36) | N/A | N/A | N/A | N/A | N/A | N/A | determine the likelihood of an outcome of a simple event. |
| N/A | N/A | ES | ES | [**4.13b**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=36) | N/A | N/A | N/A | N/A | N/A | N/A | represent probability as a number between 0 and 1, inclusive. |
| N/A | N/A | ES | ES | [**4.13c**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=36) | N/A | N/A | N/A | N/A | N/A | N/A | create a model or practical problem to represent a given probability. |
| N/A | N/A | ES | ES | ES | [**5.15**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=36) | N/A | N/A | N/A | N/A | N/A | determine the probability of an outcome by constructing a sample space or using the Fundamental (Basic) Counting Principle. |
| N/A | N/A | ES | ES | ES | ES | N/A | [**7.8a**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=25) | N/A | N/A | N/A | determine the theoretical and experimental probabilities of an event. |
| N/A | N/A | ES | ES | ES | ES | N/A | [**7.8b**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=25) | N/A | N/A | N/A | investigate and describe the difference between the experimental probability and theoretical probability of an event. |
| N/A | N/A | ES | ES | ES | ES | N/A | MS | [**8.11a**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=23) | N/A | N/A | compare and contrast the probability of independent and dependent events |
| N/A | N/A | ES | ES | ES | ES | N/A | MS | [**8.11b**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=23) | N/A | N/A | determine probabilities for independent and dependent events. |

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| **K-8 Cross-Strand Connections – Outcomes and Probability** |
| **Number and Number Sense Connections**   * [**3.2a**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=10) **-** Name and write fractions and mixed numbers represented by a model * [**3.2b**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=10) **-** Represent fractions and mixed numbers with models and symbols * [**4.2a**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=9) **-** Compare and order fractions and mixed numbers, with and without models * [**4.2c**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=9) **-** Identify the division statement that represents a fraction, with models and in context * [**5.2b**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=9) **-** Compare and order fractions, mixed numbers, and/or decimals in a given set, from least to greatest and greatest to least * [**6.2b**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=11) **-** Compare and order positive rational numbers * [**7.1c**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=8) **-** Compare and order rational numbers * [**7.2**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=12) **-** Solve practical problems involving operations with rational numbers * [**8.1**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=8) **-** Compare and order real numbers   **Computation and Estimation Connections**   * [**5.6b**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=20) **-** Solve single-step practical problems involving multiplication of a whole number, limited to 12 or less, and a proper fraction, with models * [**6.5a**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=17) **-** Multiply and divide fractions and mixed numbers * [**6.5b**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=17) **-** Solve single-step and multistep practical problems involving addition, subtraction, multiplication, and division of fractions and mixed numbers   **Measurement and Geometry Connections**  **Patterns, Functions, and Algebra Connections** |

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| **Grade  K** | **Grade  1** | **Grade  2** | **Grade  3** | **Grade  4** | **Grade  5** | **Grade  6** | **Grade  7** | **Grade  8** | **Related to Algebra 1** | **Related to Algebra 2** | **Data Representation and Interpretation** |
| [**K.11a**](https://www.doe.virginia.gov/home/showpublisheddocument/3036#page=25) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | collect, organize, and represent data. |
| [**K.11b**](https://www.doe.virginia.gov/home/showpublisheddocument/3036#page=25) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | read and interpret data in object graphs, picture graphs, and tables. |
| ES | [**1.12a**](https://www.doe.virginia.gov/home/showpublisheddocument/2936#page=29) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | collect, organize, and represent various forms of data using tables, picture graphs, and object graphs. |
| ES | [**1.12b**](https://www.doe.virginia.gov/home/showpublisheddocument/2936#page=29) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | read and interpret data displayed in object graphs, picture graphs, and tables, using the vocabulary *more*, *less*, *fewer*, *greater than*, *less than*, and *equal to*. |
| ES | ES | [**2.15a**](https://www.doe.virginia.gov/home/showpublisheddocument/2950#page=34) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | collect, organize, and represent data in pictographs and bar graphs. |
| ES | ES | [**2.15b**](https://www.doe.virginia.gov/home/showpublisheddocument/2950#page=34) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | read and interpret data represented in pictographs and bar graphs. |
| ES | ES | ES | [**3.15a**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=36) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | collect, organize, and represent data in pictographs or bar graphs. |
| ES | ES | ES | [**3.15b**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=36) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | read and interpret data represented in pictographs and bar graphs. |
| ES | ES | ES | ES | [**4.14a**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=38) | N/A | N/A | N/A | N/A | N/A | N/A | collect, organize, and represent data in bar graphs and line graphs. |
| ES | ES | ES | ES | [**4.14b**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=38) | N/A | N/A | N/A | N/A | N/A | N/A | interpret data represented in bar graphs and line graphs. |
| ES | ES | ES | ES | [**4.14c**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=38) | N/A | N/A | N/A | N/A | N/A | N/A | compare two different representations of the same data. |
| ES | ES | ES | ES | ES | [**5.16a**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=38) | N/A | N/A | N/A | N/A | N/A | given a practical problem, will  represent data in line plots and stem-and-leaf plots. |
| ES | ES | ES | ES | ES | [**5.16b**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=38) | N/A | N/A | N/A | N/A | N/A | given a practical problem, will interpret data represented in line plots and stem-and-leaf plots. |
| ES | ES | ES | ES | ES | [**5.16c**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=38) | N/A | N/A | N/A | N/A | N/A | given a practical problem, will compare data represented in a line plot with the same data represented in a stem-and-leaf plot. |
| ES | ES | ES | ES | ES | ES | [**6.10a**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=27) | N/A | N/A | N/A | N/A | given a practical problem, will represent data in a circle graph. |
| ES | ES | ES | ES | ES | ES | [**6.10b**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=27) | N/A | N/A | N/A | N/A | given a practical problem, will make observations and inferences about data represented in a circle graph. |

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| **Grade  K** | **Grade  1** | **Grade  2** | **Grade  3** | **Grade  4** | **Grade  5** | **Grade  6** | **Grade  7** | **Grade  8** | **Algebra 1** | **Algebra 2** | **Data Representation and Interpretation** |
| ES | ES | ES | ES | ES | ES | [**6.10c**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=27) | N/A | N/A | N/A | N/A | given a practical problem, will compare circle graphs with the same data represented in bar graphs, pictographs, and line plots. |
| ES | ES | ES | ES | ES | ES | MS | [**7.9a**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=26) | N/A | N/A | N/A | given data in a practical situation, willrepresent data in a histogram. |
| ES | ES | ES | ES | ES | ES | MS | [**7.9b**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=26) | N/A | N/A | N/A | given data in a practical situation, willmake observations and inferences about data represented in a histogram. |
| ES | ES | ES | ES | ES | ES | MS | [**7.9c**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=26) | N/A | N/A | N/A | given data in a practical situation, willcompare histograms with the same data represented in stem-and-leaf plots, line plots, and circle graphs. |
| ES | ES | ES | ES | ES | ES | MS | MS | [**8.12a**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=25) | N/A | N/A | represent numerical data in boxplots. |
| ES | ES | ES | ES | ES | ES | MS | MS | [**8.12b**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=25) | N/A | N/A | make observations and inferences about data represented in boxplots. |
| ES | ES | ES | ES | ES | ES | MS | MS | [**8.12c**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=25) | N/A | N/A | compare and analyze two data sets using boxplots. |
| ES | ES | ES | ES | ES | ES | MS | MS | [**8.13a**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=27) | N/A | N/A | represent data in scatterplots. |
| ES | ES | ES | ES | ES | ES | MS | MS | [**8.13b**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=27) | N/A | N/A | make observations about data represented in scatterplots. |
| ES | ES | ES | ES | ES | ES | MS | MS | [**8.13c**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=27) | N/A | N/A | use a drawing to estimate the line of best fit for data represented in a scatterplot. |
| ES | ES | ES | ES | ES | ES | MS | MS | MS | [**A.9**](https://www.doe.virginia.gov/home/showpublisheddocument/2868#page=19) | N/A | collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve practical problems, using mathematical models of linear and quadratic functions. |
| ES | ES | ES | ES | ES | ES | MS | MS | MS | HS | [**AII.9**](https://www.doe.virginia.gov/home/showpublisheddocument/2880#page=20) | collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve practical problems, using mathematical models of quadratic and exponential functions. |

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| **K-8 Cross-Strand Connections – Data Representation and Interpretation** |
| **Number and Number Sense Connections**   * [**K.2a**](https://www.doe.virginia.gov/home/showpublisheddocument/3036#page=10) **-** Compare and describe one set as having more, fewer, or the same number of objects as the other set(s) * [**K.2b**](https://www.doe.virginia.gov/home/showpublisheddocument/3036#page=10) **-** Compare and order sets from least to greatest and greatest to least * [**1.2b**](https://www.doe.virginia.gov/home/showpublisheddocument/2936#page=10) **-** Compare two numbers between 0 and 110 represented pictorially or with concrete objects, using the words *greater than*, *less than* or *equal to* * [**1.2c**](https://www.doe.virginia.gov/home/showpublisheddocument/2936#page=10) **-** Order three or fewer sets from least to greatest and greatest to least * [**2.1c**](https://www.doe.virginia.gov/home/showpublisheddocument/2950#page=8) **-** Compare and order whole numbers between 0 and 999 * [**3.1c**](https://www.doe.virginia.gov/home/showpublisheddocument/2960#page=8) **-** Compare and order whole numbers, each 9,999 or less * [**4.1b**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=8) **-** Compare and order whole numbers expressed through millions * [**4.3a**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=11) **-** Read, write, represent, and identify decimals expressed through thousandths * [**4.3c**](https://www.doe.virginia.gov/home/showpublisheddocument/2972#page=11) **-** Compare and order decimals * [**5.2b**](https://www.doe.virginia.gov/home/showpublisheddocument/2984#page=9) **-** Compare and order fractions, mixed numbers, and/or decimals in a given set, from least to greatest and greatest to least * [**6.2b**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=11) **-** Compare and order positive rational numbers * [**6.4**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=15) **-** Recognize and represent patterns with whole number exponents and perfect squares * [**7.1c**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=8) **-** Compare and order rational numbers * [**8.1**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=8) **-** Compare and order real numbers   **Computation and Estimation Connections**  **Measurement and Geometry Connections**   * [**6.8a**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=23) **-** Identify the components of the coordinate plane   **Patterns, Functions, and Algebra Connections**   * [**6.12a**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=33) **-** Represent a proportional relationship between two quantities, including those arising from practical situations * [**6.12c**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=33) - Determine whether a proportional relationship exists between two quantities * [**6.12d**](https://www.doe.virginia.gov/home/showpublisheddocument/2996#page=33) **-** Make connections between and among representations of a proportional relationship between two quantities using verbal descriptions, ratio tables, and graphs * [**7.10a**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=31) **-** Determine the slope, *m*, as rate of change in a proportional relationship between two quantities and write an equation in the form *y = mx* to represent the relationship * [**7.10e**](https://www.doe.virginia.gov/home/showpublisheddocument/3008#page=31) **-** Make connections between and among representations of a proportional or additive relationship between two quantities using verbal descriptions, tables, equations, and graphs * [**8.16a**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=36) **-** Recognize and describe the graph of a linear function with a slope that is positive, negative, or zero * [**8.16d**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=36) **-** Graph a linear function given the equation *y = mx + b* form * [**8.16e**](https://www.doe.virginia.gov/home/showpublisheddocument/3020#page=36) **-** Make connections between and among representations of a linear function using verbal descriptions, tables, equations, and graphs |

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